APPENDIX C

INSTRUMENTATION AND CONTROLS DESIGN REVIEW GUIDANCE

(PROGRAMMATIC AND FACILITY)

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RECORD OF REVISIONS

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RESPONSIBLE ENGINEERING STANDARDS POC AND COMMITTEE

for upkeep, interpretation, and variance issues

Section D3060/F1050 App C	Instrumentation & Controls POC/Committee

1.0 PURPOSE AND SCOPE

This appendix provides guidance for the conduct of design reviews of Instrumentation and Control (I&C) systems. The appendix provides the means to improve consistency, overall design, equipment specification, and lifecycle maintenance. It also provides guidance for addressing technology obsolescence.

2.0 DEFINITIONS

Component Location Identifiers – A labeling designation used to identify the location of a component. It generally consists of a combination of designations such as the component area, system, equipment type, and number.

Control Philosophy – A control system design approach that consists of: (1) establishing process control objectives (functional performance descriptions, process monitoring requirements, operational limits, etc.), (2) applying the most appropriate control techniques (ratio control, feed-forward control, cascade control, etc.), and (3) ensuring control system attributes (diversity, separation, isolation, redundancy, fault diagnostics, testability, etc.) are available for the reliable, efficient, and safe control of a facility / process.

Engineering Standards Task Matrix – An application matrix that provides for the selection of a minimum set of national codes and standards to be addressed for I&C systems. Refer to the I&C Chapter, Section 200 – D3060/F1050, Subsection 3.4.

Functional Classification – A graded classification system used to determine the minimum requirements for Systems, Structures, and Components (SSCs) (e.g. design, operation, procurement, and maintenance requirements). The four Functional Classifications in order of precedence are ML-1 and/or SC, ML-2 and/or SS, ML-3, and ML-4.

Instrument Range – The region between the limits within which a quantity is measured, received, or transmitted, expressed by stating the lower and upper range values. It is often expressed as the difference between the upper and lower measurable limits.

Instrument Scale – The graduated series of marking on an instrument display, usually used in conjunction with a pointer to indicate a measured value.

Instrument Sensitivity – The smallest change in actual value of a measured quantity that will produce and observable change in an instrument's output.

Measurement and Test Equipment (M&TE) – Portable or fixed equipment used for acceptance, calibration, measurement, gauging, testing, and/or inspection of equipment in order to control or acquire data to verify conformance to specified requirements or for reference information (monitoring and data collection).

Safety Significant Instrumented System – An SS system or 29 CFR 1910.119 hazardous process independent protection layer that requires instrumentation, logic devices and final control elements to monitor and detect an SS event, and which will result in automatic or operator action that will bring the facility or process system to a safe state.

3.0 METHODOLOGY

A. An attachment to this appendix (Attachment 1) provides a checklist that can be used to address the quality of an I&C system design. The questions are worded such that the desirable answer is "Yes". It is, however, understood that not all questions are applicable to all I&C systems. The number of questions that are applicable and are answered "Yes" will be indicative of the quality of design.

B. Maximum benefit is obtained when the attached checklist is used throughout the design phase. Completing the checklist at the beginning of a design task insures that the proper considerations are given and can reveal inconsistencies in the design approach. The checklist should be used during design reviews to assess the extent of progress in meeting the intent of the questions. For the final design review, the checklist provides a means to assess the completeness and quality of the system design.

Attachment 1: Control System Design Checklist

Obsolescence

1. Is there a provision in the bid specification for migration to newer technologies?	☐ Yes	☐ No	☐ N/A
2. Does the supplier have a migration plan to newer technology covering the next 5 to 10 years?	☐ Yes	☐ No	☐ N/A
3. Is there a good balance between proven and new technology? (e.g., Equipment is not approaching obsolescence, but is not untested technology either.)	☐ Yes	☐ No	☐ N/A
4. Are spare parts available as "off-the-shelf" items?	☐ Yes	☐ No	☐ N/A
5. Has the supplier provided a product support plan that covers at least five years following product delivery?	☐ Yes	☐ No	☐ N/A
6. Are there alternate sources available for the chosen components and are they compatible?	☐ Yes	☐ No	☐ N/A
7. Does the supplier have a good record of product support?	☐ Yes	☐ No	☐ N/A
8. Is the supplier considered to be a stable, viable supplier?	☐ Yes	☐ No	☐ N/A

Consistency

1. Has the I&C system design been reviewed for consistency of design? (See five sub-questions below)	☐ Yes	☐ No	☐ N/A
1.1 Can the system be operated and maintained without any significant additional site training for operations or maintenance personnel?	☐ Yes	☐ No	☐ N/A
1.2 Can existing facility procedures be utilized, or slightly modified in use, in order to operate the new control system?	☐ Yes	☐ No	☐ N/A
1.3 Can a common set of spare parts be used to maintain the proposed new system and exiting facility systems?	☐ Yes	☐ No	☐ N/A
1.4 In the event of multiple design groups or engineers, have difference segments of the new I&C system been designed so that the same control strategy is used	☐ Yes	☐ No	☐ N/A
1.5 In the event of similar existing systems within the facility, has the new I&C system been designed so that it employs the same control strategy as the existing systems?	☐ Yes	☐ No	☐ N/A
2. Does the I&C system design support a uniform and consistent operating philosophy? (See four sub-questions below)	☐ Yes	☐ No	☐ N/A
2.1 Are instruments that make similar measurements the same type of instruments? (e.g., all similar flows measured with the same type of flow meter?)	☐ Yes	☐ No	☐ N/A

2.2 Are alerts/alarms/interlocks for similar functions applied, prioritized, and handled in a consistent manner?	☐ Yes	☐ No	☐ N/A
2.3 Is process data being presented (display/engineering units/accuracy) in a consistent manner for similar applications?	☐ Yes	☐ No	☐ N/A
2.4 Is the instrument scale consistent with instruments that make similar measurements?	☐ Yes	☐ No	☐ N/A
3. Is the I&C system design consistent with the requirements established for the proposed functional classification?	☐ Yes	☐ No	☐ N/A
4. Have Component Location Identifiers (CLI) been assigned in a consistent manner with other similar systems in the facility?	☐ Yes	☐ No	☐ N/A
5. Are process displays consistent with applicable standards and existing conventions?	☐ Yes	☐ No	☐ N/A
6. Is the new I&C system equipment compatible with existing telecommunications equipment?	☐ Yes	☐ No	☐ N/A
7. Is the new I&C system compatible with existing systems with which it interfaces?	☐ Yes	☐ No	☐ N/A
8. Are databases (e.g., instrument index, I/O, alarm setpoint) established in the design consistent with existing databases?	☐ Yes	☐ No	☐ N/A

Technology

1. Has control software been developed in accordance with the specified facility software requirements?	☐ Yes	☐ No	☐ N/A
2. Is the instrumentation the most appropriate for the type and range of measurement?	☐ Yes	☐ No	☐ N/A
3. Can the supplier provide an upgrade path for the I&C components to provide compatibility with fieldbus architecture if applicable?	☐ Yes	☐ No	☐ N/A
4. Does the I&C system utilize industry standard communication protocols instead of proprietary ones?	☐ Yes	☐ No	☐ N/A
5. Does the I&C system have the capability to easily add more I/O points or drops?	☐ Yes	☐ No	☐ N/A
6. Are on-line and/or self-diagnostics included in the system design?	☐ Yes	☐ No	☐ N/A
7. Does the system provide on-line help for operators and engineers?	☐ Yes	☐ No	☐ N/A
8. Can the system provide printouts of its configurations, logic, and executables for documentation purposes?	☐ Yes	☐ No	☐ N/A

Good Design Practice

1. Is a control philosophy established for the facility?	☐ Yes	☐ No	☐ N/A
2. Are commercial “off-the-shelf” products being used to the maximum extent in the new design?	☐ Yes	☐ No	☐ N/A
3. Has energy efficiency been considered between design alternatives?	☐ Yes	☐ No	☐ N/A

4. Has the heat load on the HVAC system resulting from the installation of additional equipment been taken into consideration?	☐ Yes	☐ No	☐ N/A
5. Has a human factors approach been applied in the design of operator workstations and any other Human Machine Interfaces?	☐ Yes	☐ No	☐ N/A
6. Have power sources been identified for electrical load studies?	☐ Yes	☐ No	☐ N/A
7. Has the system been designed to be fail-safe?	☐ Yes	☐ No	☐ N/A
8. Has the National Codes and Standards Task Matrix been reviewed for applicable I&C design standards for the proposed functional classification?	☐ Yes	☐ No	☐ N/A
9. Has the system been reviewed for security requirements established for computer-based control systems?	☐ Yes	☐ No	☐ N/A
10. Have all instruments been placed so that they meet guidelines for accessibility and proper operation?	☐ Yes	☐ No	☐ N/A
11. Have all instruments and actuators been sized to meet minimum, maximum, and nominal process operating conditions.	☐ Yes	☐ No	☐ N/A
12. Has the instrument, instrument range, and instrument sensitivity been selected based on operational process sensitivity requirements?	☐ Yes	☐ No	☐ N/A
13. Has the design team agreed on the design standards that will be applied?	☐ Yes	☐ No	☐ N/A
14. Has space for expansion been provided if required for operation in the future?	☐ Yes	☐ No	☐ N/A
15. Are I&C materials of construction compatible with process materials and the operating environment?	☐ Yes	☐ No	☐ N/A
16. Has the system availability and reliability requirements been identified and met in the design?	☐ Yes	☐ No	☐ N/A
17. Has a life cycle cost analysis been performed and is the selected system competitive when compared to other designs?	☐ Yes	☐ No	☐ N/A
18. Has the supplier been qualified and placed on an approved supplier's list?	☐ Yes	☐ No	☐ N/A
19. Does the design specification include a factory acceptance test?	☐ Yes	☐ No	☐ N/A
20. Does the supplier specification require that the supplier be compliant with NQA-1 and that the supplier identify, in his proposal, all deliverables including lifecycle documentation?	☐ Yes	☐ No	☐ N/A
21. Has the appropriate design requirements been applied to ML-2 / Safety Significant instrumented systems?	☐ Yes	☐ No	☐ N/A
22. Has the control system design been reviewed to ensure it does not interfere with existing monitoring, alarm, and safety systems?	☐ Yes	☐ No	☐ N/A
23. Is the proper level of receipt inspection included in the purchasing documents?	☐ Yes	☐ No	☐ N/A
24. Is documentation for the application of DOE G 420.0 standards provided?	☐ Yes	☐ No	☐ N/A

Maintenance

1. Has instrumentation been modularized where possible for low maintenance and repair costs?	☐ Yes	☐ No	☐ N/A
2. Does the purchase requisition require the vendor to supply specification sheets in hard and electronic copy?	☐ Yes	☐ No	☐ N/A
3. Does the design allow for maintenance to be conducted with minimum or no impact to plant operation?	☐ Yes	☐ No	☐ N/A
4. Does the purchase requisition require the vendor to supply calibration certification, M&TE requirements, and procedures for any unique or special instruments?	☐ Yes	☐ No	☐ N/A
5. Has the Procurement Department's controlled product list been reviewed to ensure no suspect materials are being used as critical components?	☐ Yes	☐ No	☐ N/A
6. Are appropriate features available for calibrating / testing?	☐ Yes	☐ No	☐ N/A
7. Are items accessible and oriented for support by construction and maintenance?	☐ Yes	☐ No	☐ N/A
8. Can the system be maintained without special calibration equipment or procedures?	☐ Yes	☐ No	☐ N/A
9. Has weather protection been provided where necessary?	☐ Yes	☐ No	☐ N/A
10. Has the I&C system design taken into consideration ALARA issues for maintenance and operational personnel?	☐ Yes	☐ No	☐ N/A
11. Does the supplier offer training for maintenance personnel on its I&C components if necessary?	☐ Yes	☐ No	☐ N/A
12. Does the I&C system design incorporate features to limit system susceptibility to electrical noise, ground loops, static electricity, lightning strikes and electrical surges?	☐ Yes	☐ No	☐ N/A
13. Has the supplier demonstrated a good quality assurance program and a quality product? (e.g., Records do not indicate quality concerns with the supplier's products)	☐ Yes	☐ No	☐ N/A